TRIODE-OUTPUT PENTODE

The triode section is intended for use as frame oscillator and A.F. amplifier. The pentode section is intended for use as frame output tube and A.F. power amplifier.

QUICK REFERENCE DATA			
Triode section			
Anode current	I_a	3.5	mA
Transconductance	S	2.2	mA/V
Amplification factor	μ	70	-
Pentode section			
Anode peak voltage	V_{a_p}	max. 2.5	kV
Anode current	I_a	41	mA
Transconductance	S	7.5	mA/V
Amplification factor	$\mu_{g_2g_1}$	9.5	-
Output power	W_o	3.3	W

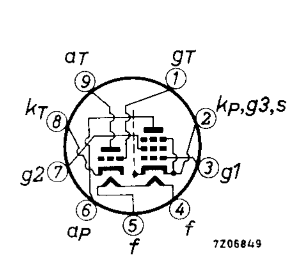
HEATING: Indirect by A.C. or D.C.; series supply

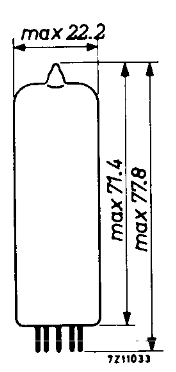
Heater current	I_f	300	mA
Heater voltage	V_f	16	V

DIMENSIONS AND CONNECTIONS

Dimensions in mm

Base: Noval





CAPACITANCES

Triode section

Anode to all except grid	$C_{a(g)}$	4.3	pF
Grid to all except anode	$C_{g(a)}$	2.7	pF
Anode to grid	C_{ag}	4.4	pF
Grid to heater	C_{gf}	max. 0.02	pF

Pentode section

Anode to all except grid No.1	$C_{a(g_1)}$	8.0	pF
Grid No.1 to all except anode	$C_{g_1(a)}$	9.3	pF
Anode to grid No.1	C_{ag_1}	max. 0.3	pF
Grid No.1 to heater	C_{g_1f}	max. 0.3	pF

Between triode and pentode sections

Anode triode to grid No.1 pentode	C_{aTg_1P}	max. 0.02	pF
Grid triode to anode pentode	C_{gTaP}	max. 0.02	pF
Grid triode to grid No.1 pentode	C_{gTg_1P}	max. 0.025	pF
Anode triode to anode pentode	C_{aTaP}	max. 0.25	pF

TYPICAL CHARACTERISTICS

Triode section

Anode voltage	V_a	100	V
Grid voltage	V_g	0	V
Anode current	I_a	3.5	mA
Transconductance	S	2.2	mA/V
Amplification factor	μ	70	-

Pentode section

Anode voltage	V_a	170	V
Grid No.2 voltage	V_{g_2}	170	V
Grid No.1 voltage	V_{g_1}	-11.5	V
Anode current	I_a	41	mA
Grid No.2 current	I_{g_2}	9	mA
Transconductance	S	7.5	mA/V
Amplification factor	$\mu_{g_2g_1}$	9.5	-
Internal resistance	R_i	16	kΩ

OPERATING CHARACTERISTICS

Triode section as A.F. amplifier

A.

Signal source resistance	R_s	0.22		MΩ
Grid resistor	R_g	3		MΩ
Grid resistor of next stage	$R_{g'}$	0.68		MΩ
Supply voltage	V_b	200	170	V
Cathode resistor	R_k	2.2	2.7	kΩ
Anode resistor	R_a	220	220	kΩ
Anode current	I_a	0.52	0.43	mA
Voltage gain	V_o/V_i 1)	52	51	-
Max. output voltage	$V_{o\,max}$	26	25	V_{RMS}
Distortion	d_{tot} 2)	1.6	2.3	%

B.

Signal source resistance	R_s	0.22				MΩ
Grid resistor	R_g	22				MΩ
Grid resistor of next stage	$R_{g'}$	0.68				MΩ
Supply voltage	V_b	200	200	170	170	V
Cathode resistor	R_k	0	0	0	0	Ω
Anode resistor	R_a	100	220	100	220	kΩ
Anode current	I_a	1.05	0.61	0.86	0.50	mA
Voltage gain	V_o/V_i 1)	50	55	49	53	-
Max. output voltage	$V_{o\,max}$	24	25	19	20	V_{RMS}
Distortion	d_{tot} 3)	1.5	1.4	1.4	1.4	%

MICROPHONY AND HUM

The triode section can be used without special precautions against microphony and hum in circuits in which an input voltage $V_i \geqq 10$ mV_{RMS} gives an output of 50 mW of the output stage. Z_g (50 Hz) = 0.25 MΩ. The A.C. voltage between pin 4 and cathode should not exceed 6.3 V. If the tube is used in television circuits where the frequency of the heater supply is not synchronized with the frame frequency, this may cause interference due to hum. At page 8 the relation is shown between the permissible value of Z_{g1} of the pentode section and the A.C. voltage between pin 4 and the cathode. This curve applies to C_{g1f} is 0.8 pF (inclusive of wiring and tube socket).

1) Measured at small input voltage
2) At lower output voltages the distortion is proportionally lower.
3) At lower output voltages down to 5 V_{RMS} the distortion remains approximately constant. At values below 5 V_{RMS} the distortion is approximately proportional to V_o.

OPERATING CHARACTERISTICS

Pentode section

A.F. power amplifier, class A (measured with V_k constant)

Supply voltage	$V_{ba}=V_{bg_2}$		170			200			230		V
Grid No.2 series resistor (non-decoupled)	R_{g_2}		0			470			1200		Ω
Cathode resistor	R_k		200			330			490		Ω
Load resistance	$R_{a\sim}$		3.25			4.5			6		kΩ
Grid No.1 driving voltage	V_i	0	0.61	5.9	0	0.66	6.7	0	0.75	7.8	V_{RMS}
Anode current	I_a	42	-	44	35	-	37	30	-	31	mA
Grid No.2 current	I_{g_2}	9.2	-	15.5	7.8	-	13.3	6.6	-	11.0	mA
Output power	W_o	0	0.05	3.2	0	0.05	3.3	0	0.05	3.25	W
Distortion	d_{tot}	-	-	10	-	-	10	-	-	10	%

A.F. power amplifier, class AB, two tubes in push-pull

Anode supply voltage	V_{ba}	200		230		V
Grid No.2 supply voltage	V_{bg_2}	200		200		V
Common cathode resistor	R_k	170		200		Ω
Load resistance	$R_{aa\sim}$	4.5		7		kΩ
Grid No.1 driving voltage	V_i	0	14.2	0	13.0	V_{RMS}
Anode current	I_a	2x35	2x42.5	2x30	2x34.5	mA
Grid No.2 current	I_{g_2}	2x8	2x16.5	2x6.2	2x13.5	mA
Output power	W_o	0	9.3	0	10	W
Distortion	d_{tot}	-	6.3	-	5.5	%

Frame output application

The circuit should operate satisfactorily with peak anode current I_{a_p} = 85 mA at V_a = 50 V, V_{g_2} = 170 V, I_f = 300 mA. The minimum available I_{a_p} value at end of life is

70 mA at V_a = 50 V, V_{g_2} = 170 V, I_f = 280 mA
80 mA at V_a = 50 V, V_{g_2} = 190 V, I_f = 280 mA

LIMITING VALUES (Design centre rating system)

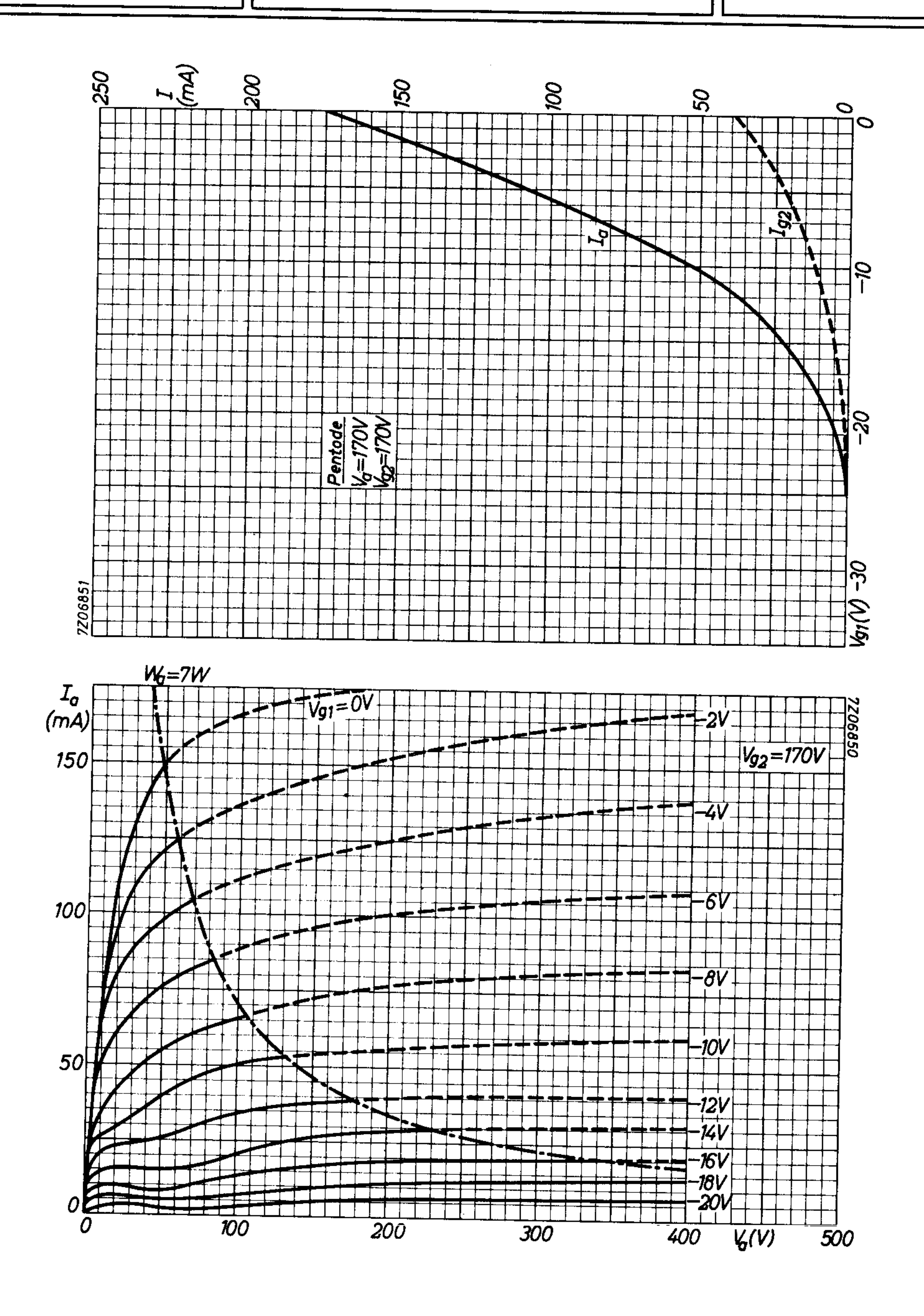
Triode section

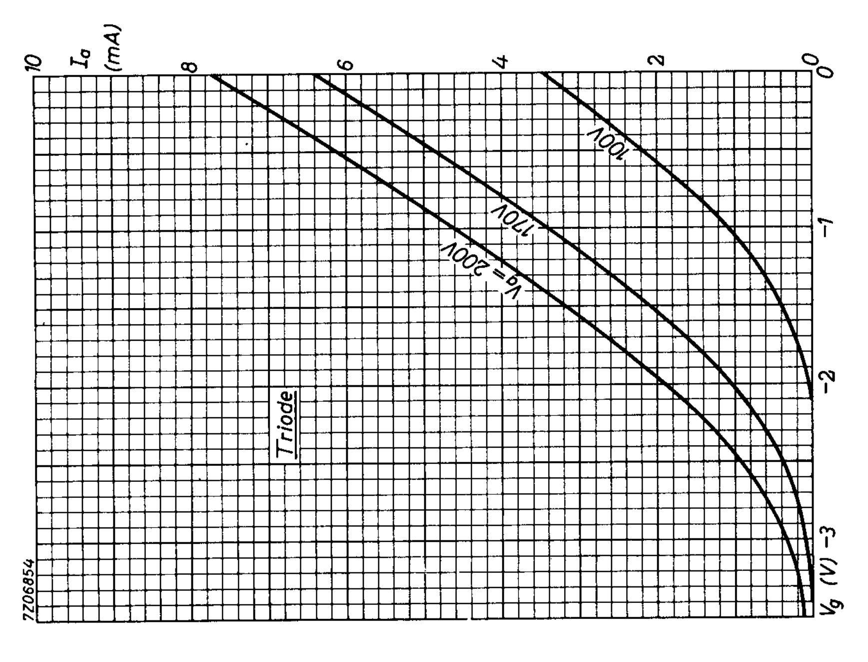
Anode voltage	V_{a_o}	max.	550	V
	V_a	max.	250	V
Anode peak voltage	V_{a_p}	max.	600	V [1]
Anode dissipation	W_a	max.	1	W
Cathode current, average	I_k	max.	15	mA
peak	I_{k_p}	max.	100	mA [1]
Grid resistor, for fixed bias	R_g	max.	1	MΩ
for automatic bias	R_g	max.	3	MΩ
Grid impedance at 50 Hz	Z_g	max.	0.5	MΩ
Cathode to heater voltage	V_{kf}	max.	200	V

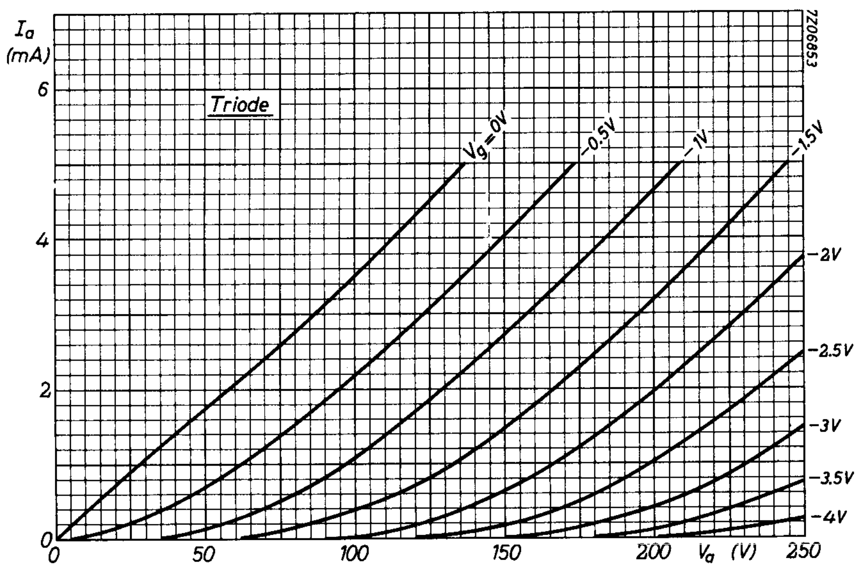
Pentode section

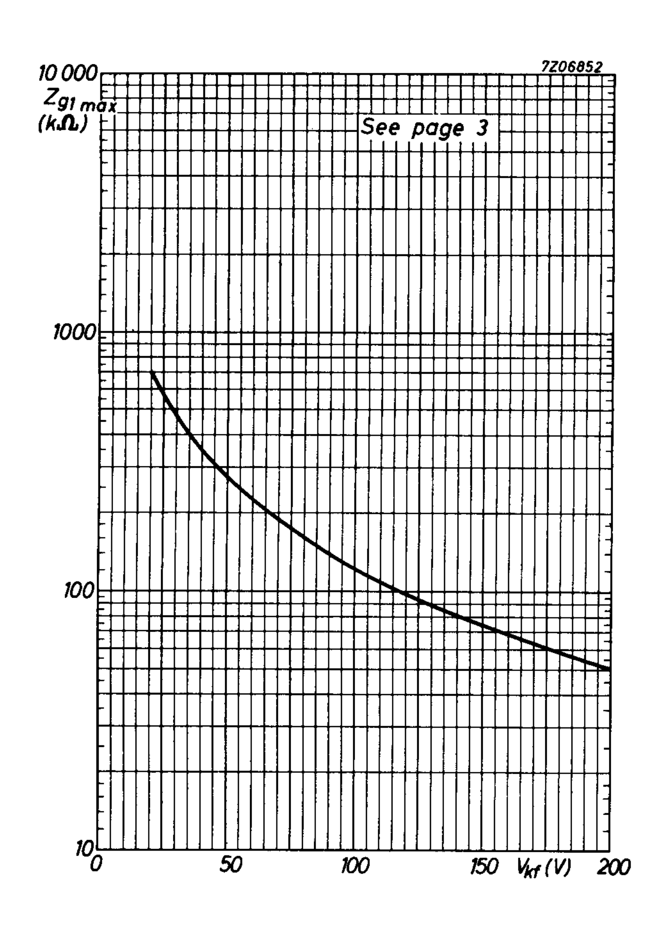
Anode voltage	V_{a_o}	max.	550	V
	V_a	max.	250	V
Anode peak voltage, positive	V_{a_p}	max.	2.5	kV
negative	$-V_{a_p}$	max.	500	V
Grid No.2 voltage	$V_{g_{2o}}$	max.	550	V
	V_{g_2}	max.	250	V
Anode dissipation for frame output application	W_a	max.	5	W
for A.F. output application	W_a	max.	7	W
Grid No.2 dissipation, average	W_{g_2}	max.	1.8	W
average for frame output application (W_a max 4 W)	W_{g_2}	max.	2	W
peak	$W_{g_{2p}}$	max.	3.2	W
Cathode current	I_k	max.	50	mA
Grid No.1 resistor, for fixed bias	R_{g_1}	max.	1	MΩ
for automatic bias	R_{g_1}	max.	2	MΩ
Cathode to heater voltage	V_{kf}	max.	200	V

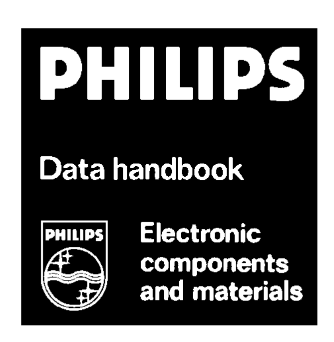
[1] Max. pulse duration 4% of a cycle with a maximum of 0.8 msec.


250
I (mA)
200
150
100
50
0
0
-10
-20
-30
V_{g1}(V)
I_a
I_{g2}
Pentode
V_a=170V
V_{g2}=170V
7Z06851
W_a=7W
I_a (mA)
150
100
50
0
V_{g1}=0V
-2V
V_{g2}=170V
7Z06850
-4V
-6V
-8V
-10V
-12V
-14V
-16V
-18V
-20V
0
100
200
300
400
V_a(V)
500


10
I_a (mA)
8
6
4
2
0
0
−1
−2
−3
V_g (V)
100V
170V
V_a = 200V
Triode
7Z06854


I_a (mA)
6
4
2
0
Triode
V_g=0V
−0.5V
−1V
−1.5V
−2V
−2.5V
−3V
−3.5V
−4V
0
50
100
150
200
V_a (V)
250
7Z06853


7Z06852
10 000
$Z_{g1\,max}$
(kΩ)
See page 3
1000
100
10
0
50
100
150
V_{kf} (V)
200



PCL82

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8	8	1970.01
9	FP	1999.08.02